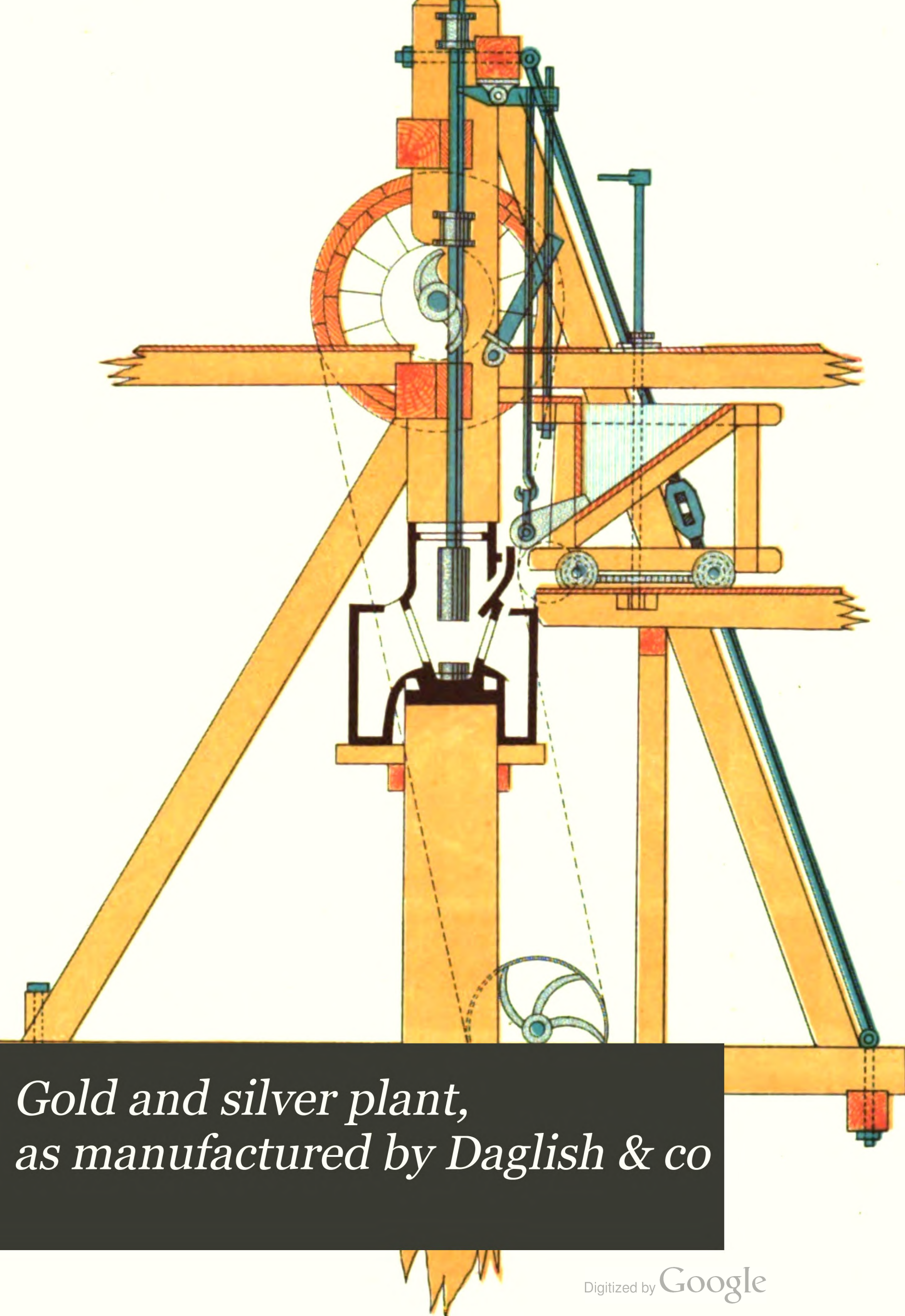


Gold and silver plant,
as manufactured by Daglish & co

GOLD & SILVER

PLANT,

BY GEO. HEATON DAGLISH, C.E. & M.E.,

AND AS

MANUFACTURED BY

DAGLISH * & * CO.,

ST. HELEN'S

ENGINE, BOILER, BRIDGE WORKS & FOUNDRY,

LANCASHIRE,

ENGLAND.

1886.

"GOLD MINING PLANT."

[By Geo. Heaton Daglish, M.I.C.E. & M.E.]

IN the practice of any manufacture every country developes features which are peculiar to itself. In no country is this more true than in the Gold and Silver Metallurgical practice of the Pacific Coast of the United States of America, and which has grown up perfectly free from and untrammelled by old customs and processes. These experiments have been made with almost every process ever brought out—both old and new. The Stamp Mill, crude and clumsy in other countries, has in California come to be as perfect as the principles of its working will permit. The process of Pan Amalgamation is peculiar to the above country, and no simpler process has been yet brought out.

GOLD.—REDUCTION OF.

The extraction of gold from auriferous quartz differs considerably with the location of the mine, and the character of the rock obtained. Amalgamation is commenced in the battery of some mills, the amalgam being collected upon silver-plated copper plates set in the mortar or battery, and upon the apron, and much is collected from the bottom of the mortar.

The sands and amalgam which pass the apron are subjected to a first concentration in blanket sluices, while that which escapes the blankets is passed through the first concentration, and then through the second concentration into the tailing sluices outside of the mill.

That which is caught in the blankets is washed from them, and after being passed through wood vats and over copper riffles goes through the second concentration into the tailing sluice.

In other mills the sands and amalgam which pass over the apron of the battery flow along sluices lined with copper, and then over blankets and through two sets of concentrators: the blanket washings being also concentrated.

There is some doubt as to the economy of the use of blankets for concentrating, especially since everything gathered in the blankets goes through the concentrator.

In experiments to test the relative efficiency of blankets and concentrators, it was found that the same weight of concentrated matter from the concentrators yielded much more gold than the blanket sands.

This would seem to indicate that with battery amalgamation discharging immediately into concentrators, as good results may be attained as by the use of blanket sluices, and at a much less expense, the labour of blanket washing being altogether avoided.

The tailings from the concentrators are passed through a Wheeler Amalgamating Pan and a settler, and then run off from the mill.

The amalgam is gathered and strained and then retorted, to separate the gold from the quicksilver, which is afterwards melted in the melting furnace and run into bars.

The sulphurets, which are concentrated and delivered by the concentrators, are roasted in reverberatory furnaces, and then reduced in chlorination works.

The general arrangements on pages 10 and 11 give in section a gold mill erected on two different styles.

SILVER ORES.—REDUCTION OF.

The method most adopted for obtaining silver from its ores is that known as the Pan Amalgamation Process, as in the reduction of gold ores there are some few minor differences of arrangement and practice.

The ore is first reduced to pulp by the Rock Breaker and the Stamp Battery, the degree of its fineness being regulated by the texture of the battery screen. When the pulp is to be roasted before amalgamation the rock is crushed dry. In this case the drying floor is built behind the battery, between it and the Rock Breaker. This floor is made with cast iron plates, three feet square, with flanges on the sides, so that all plates may overlap one another and have a flat surface for the rock on the top.

A flue runs underneath this floor, and the hot gases from the roasting furnaces serve for heating and drying the ore.

From the drying floor the ore is either fed by hand to the batteries, or is put into the boxes of the self-feeder, which are filled by the attendant.

The mortar for dry crushing differs from the wet crushing gold mortar, in that the screens are generally set with some inclination from the perpendicular. The pulp is gathered from the mortars into a screw carrier on each side of the battery, which transports it to the elevator. The elevator raises it to the pulp feeder of the furnace into which it is fed, to be roasted and chloridized. From the roasting furnace the pulp is drawn out on the cooling floor, to become cool before being charged into the amalgamating pans. After having been amalgamated in the pan the charge is run into the settler, where it is washed with water, all the fine stuff running off and leaving the amalgam to be gathered and strained preparatory to being retorted. In some mills an agitator receives that which runs from the settlers, and gathers whatever quick-silver or amalgam may have passed out of the settler. The general proportion of pans, settlers, and agitators to one another is two pans to each settler, and two settlers to each agitator, the size of all being dependent on the size of the pan.

In a dry crushing mill, without roasting, the whole arrangement is about the same, with the exception of the furnace and its dependencies.

In a wet crushing mill the mortar is adapted particularly to wet crushing, and water is fed continuously into the battery with the rock.

The wet pulp is conducted into settling tanks from which it is shovelled to be charged into the pans, and treated as before described.

A dry crushing silver mill, with roasting furnace, is given at page 12. This mill is a self-feeder, and that known as Stanford's patent, and has a Stetefeldt Furnace for roasting the pulp.

The Rock Breaker is placed at such a height behind the battery as to deliver the broken ore upon the drying floor, where it thoroughly dries by the heat of the waste gases from the Stetefeldt Furnace.

From the drying floor it is shovelled into the hopper car of the Stanford Self Feeder, when all further handling of it ceases until it is drawn from the base of furnace shaft.

The pulp is delivered from the battery into a conveyance on each side, which elevates it to the elevator bin. The elevator is shown reaching from the bin to the pulp feeder on the top of the furnace shaft, which is kept continually supplied by the discharging of the elevator, and is operated by a belt from the counter shaft. By means of two sets of cone pulleys the speed of the pulp feeder shaft may be varied from 40 revolutions to 300 revolutions per minute. The roasted pulp is drawn from the furnace by the door at the bottom of the shaft on to the cooling floor, and is then charged into the amalgamating pans.

The wet crushing silver mill, as illustrated on page 10, is of improved pattern.

The illustration will be easily understood from the description of the dry crushing mill previously given.

This mill has sixty stamps, thirty of which are arranged for wet crushing, and the other thirty for dry crushing and amalgamation without roasting. It will be seen from the cut that the pulp runs from the battery into the settling tanks, and then is passed through the pan settlers and agitators as described before.

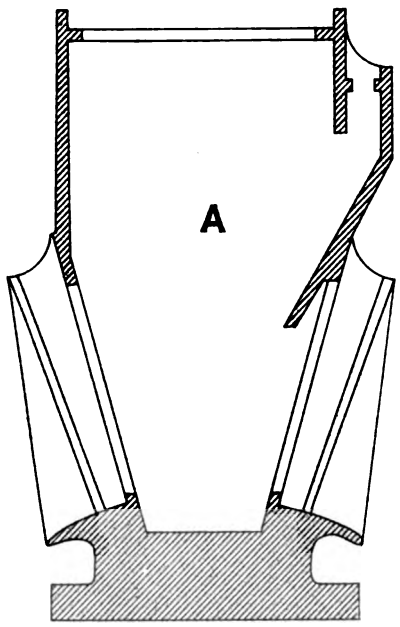
MACHINERY FOR GOLD AND SILVER MILLS.

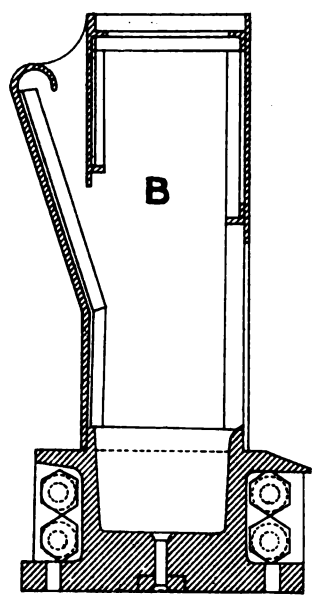
BLAKE'S PATENT ROCK BREAKER is that usually adopted.

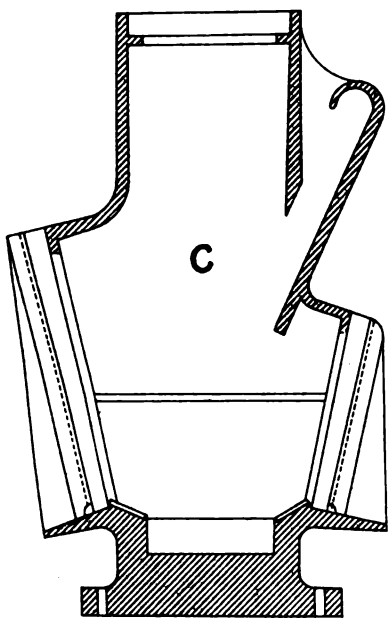
BATTERIES (OR STAMPER BATTERIES)

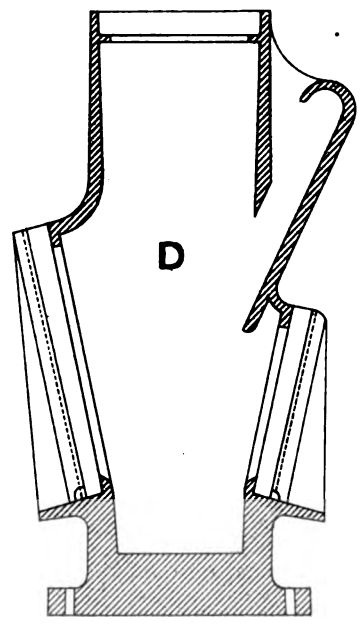
CONSIST OF

MORTARS, CAMS, CAM SHAFT, STAMP STEMS, SOCKETS, SHOES, DIES, GUIDES AND SCREENS.









MORTARS.

Mortars are constructed so as to be adapted to the peculiar conditions of their use. The Mortar for Dry Crushing is suitable for either Gold or Silver, while with Wet Crushing the Gold Mortar differs from that used for Silver. When it is necessary to have this plant light for convenience of carriage the Mortars are made in sections.

DRY MORTAR.—The Dry Mortar (A) and Sectional Mortar (B) are given on page 3. In this pattern of Mortar the Die is set high, as in the Wet Mortar for Gold. The Screens are more inclined from the perpendicular than those of Wet Mortars, and there is a double discharge. The width of the bottom, upon which the Die is set, is about 11 inches for a Die 8 inches in diameter, while the outside length is about 52 inches.

SECTIONAL MORTAR. In the Sectional Mortar (B) the upper part is made of Wrought Iron or Steel Boiler Plate, fastened at the corners by Angle Iron. The Bed is of Cast Iron, in sections, cut transversely. A bar of wrought iron is fitted into a groove planed in the bottom, with rivets holding it securely to the sections; this prevents any working of the sections sideways. The sections are firmly bolted together by strong bolts turned to size. This Mortar, when set up, is very stiff, and enduring.

WET-CRUSHING MORTARS, FOR GOLD AND SILVER.—The Mortar for Gold (C) used with Wet-Crushing is adapted to be lined with Copper Plate. The Screen Doors are also lined with copper, and the discharge is above the lining.

The general shape of the Silver Mortar for Wet-Crushing (D) is almost identically the same as the Gold Mortar. The Die, however, sets lower, while the Screens, for which openings are made on each side, are brought nearer to the middle line of the stamp, and have their whole surface available for discharge.

CAMS.

Cams as given in sketch herewith are used with either one or two arms. The single-armed Cam will permit greater speed of stamps than the double-armed Cam, it will work up as high as 110 drops per minute. The great majority of Mills use double-armed Cams, in order to avoid friction of the Cam shaft, since they give two drops of the stem to every revolution of the shaft. Fig. 1.

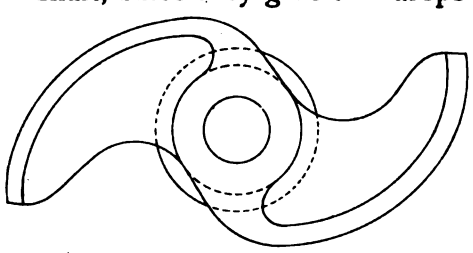
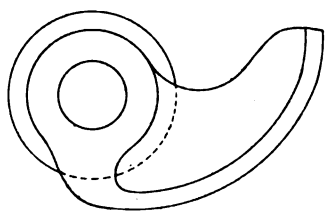


FIG 1



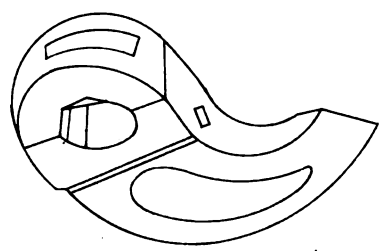
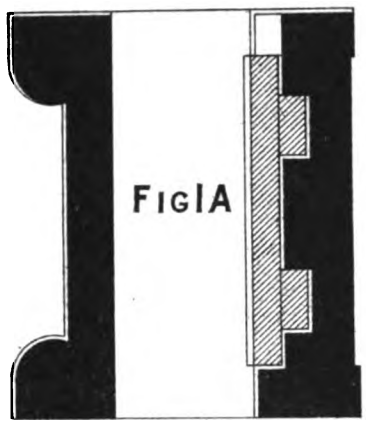


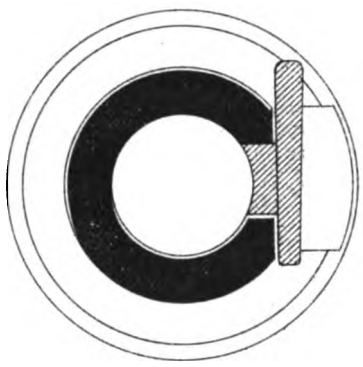
FIG 2

Cams can be made of steel, and, for convenience of quickly taking to pieces without removal of Cam Shaft, they can be manufactured in two pieces, as above. Fig. 2.



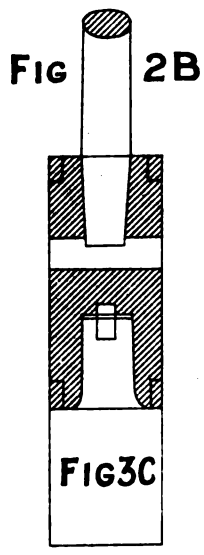
TAPPETS.

The tappet, or lifter—as it is sometimes called—is secured upon the upper part of the stem, and forms a projection under which the cam catches and lifts the stamp. Fig. 1, A, is a vertical section of the tappet. It is made of cast iron, and weighs from 60 to 70 lbs. It is alike at both ends, so that when one face becomes worn it can be reversed upon the stem.



SOCKETS.

The stamp head or socket as per Fig. 2, B, is cylindrical, and made of tough cast iron, and strengthened at each end with wrought iron bands, which are put on whilst hot.



SHOES AND DIES.

The form of shoe is shown by Fig. 3, C, and the die Fig. 4, D. Both are cylindrical, and are cast of the hardest and toughest white iron.

CAM SHAFTS.

The cam shafts are turned and made of wrought iron or steel, and usually $4\frac{1}{2}$ in. diameter for five stamps, and 5 in. diameter if for working ten stamps, with bearings at each end of battery post or upright.

The cams are bored out and fitted with one key in regular rotation round the shaft, so as to lift the Stamps successively.

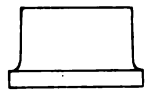
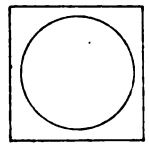


FIG 4D

GUIDES.

The guides through which the stamper stem runs are usually made of the hardest wood, such as Greenheart, and are constructed in halves, so that when worn by the stem they may be closed up.



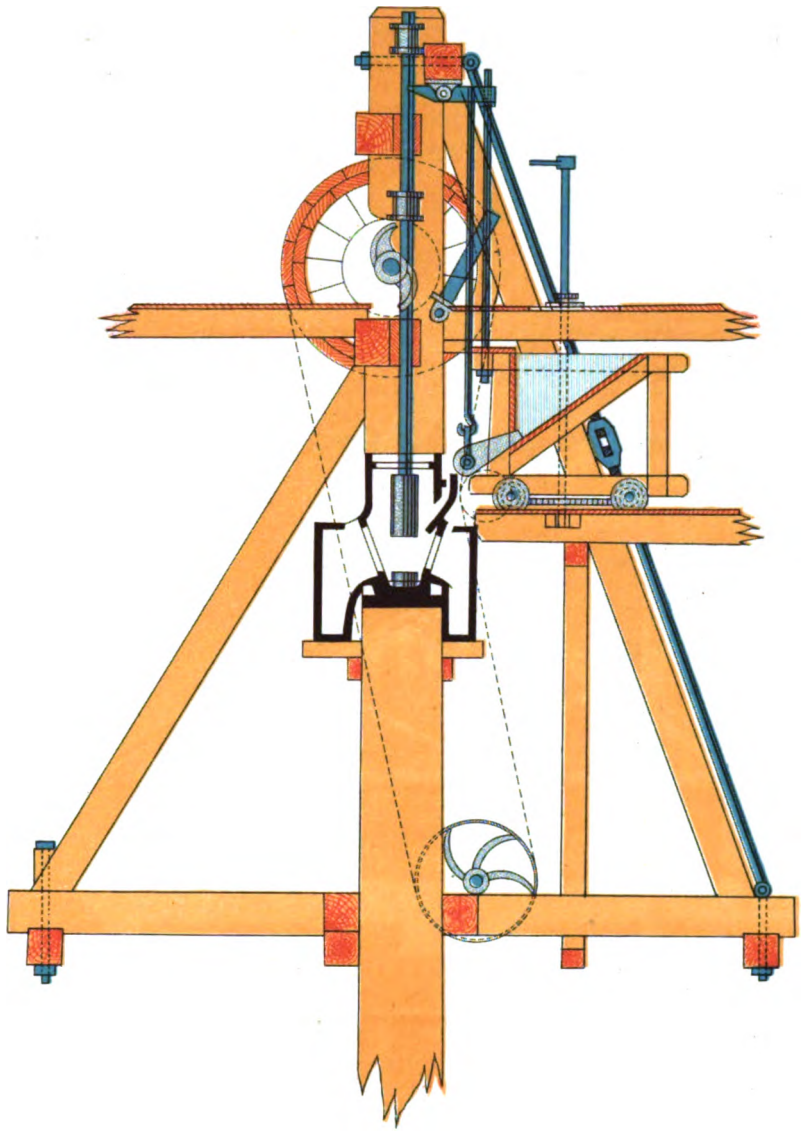
SCREENS.

The screen used for working ores by the wet process is usually made of Russia sheet charcoal iron. The sheet is perforated by punches, varying in size from the number 0 to the number 10 common sewing needle. The screen for working ores dry is usually made of wire, and varies in fineness from 900 to 10,000 meshes to the square inch.

STAMPER BATTERY,

WITH SELF-FEEDER,

FIG I.



BY

DAGLISH & Co.

STAMPER BATTERY,

WITH PATENT SELF-FEEDER, FOR CRUSHING DRY.

This is a device for keeping the mortar of the Stamp Batteries supplied with rock automatically. It is very simple in construction and application, and is not liable to get out of order, doing its work in a complete and satisfactory manner wherever it has been put into use. Fig. 1, page 5.

Its principle action is such that, when by reason of the pulverization and removal of the rock from under the stamp, it drops below a certain point, a jar is given to the shoe of a Hopper car, which causes the discharge of a quantity of rock into the mortar.

GRINDING AND AMALGAMATING PANS.

The amalgamating pan is used mostly in silver mills, one pan being enough for a forty stamp gold mill, while as many as sixteen are necessary for a silver mill of the same size.

There is no essential difference in the operation of the different styles of pans as now manufactured, the variations being in the convenience of arrangement and size, or for working and clearing up.

We illustrate on pages 7, 8, and 9, some of the amalgamating pans, &c., No. 1, 2, and 3 made by us.

There are many other kinds of pans known under the following names :—

The Wheeler Pan.	The Patton Pan.
The Horn Pan.	The Combination Pan.

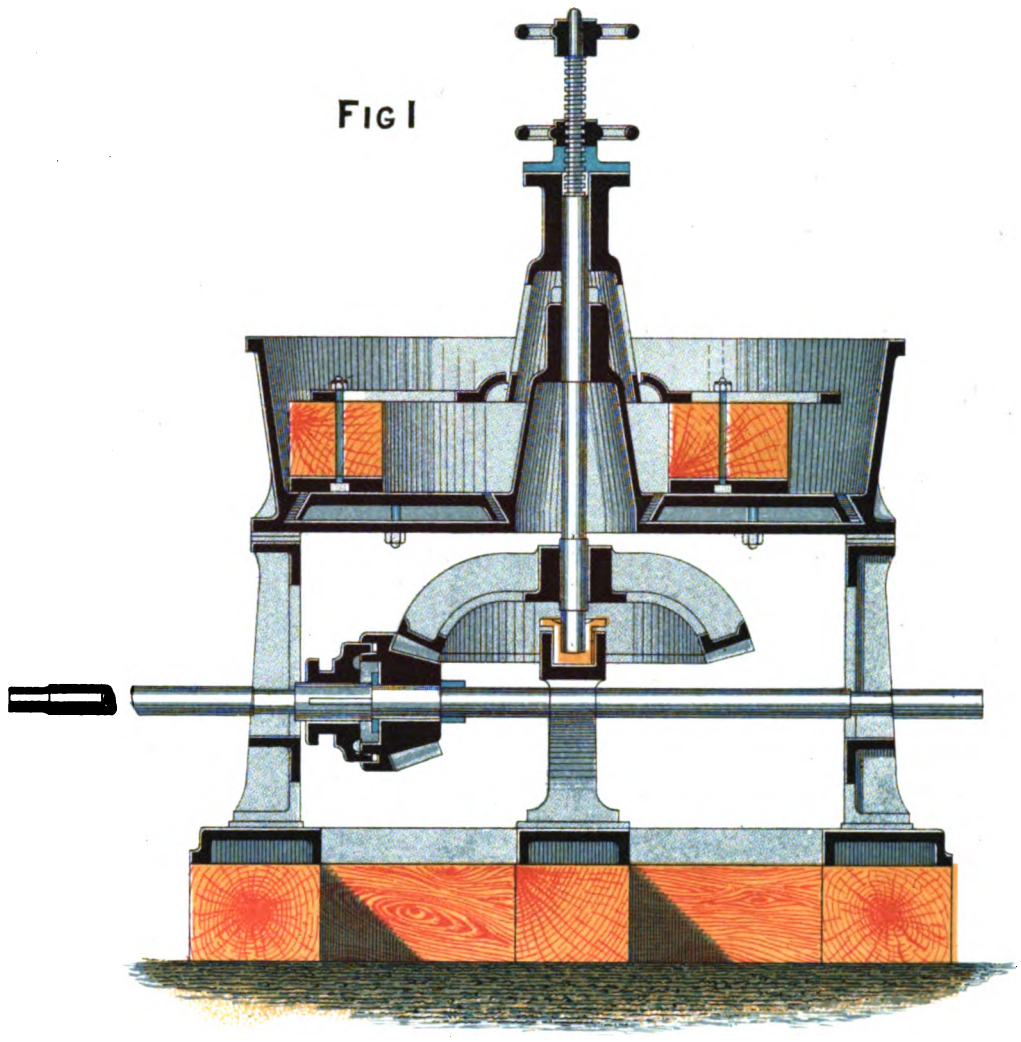
Also Settlers, Agitators, and Hardy's Concentrators.

SECTION OF AMALGAMATOR

FOR

GOLD AND SILVER MINING.

FIG I

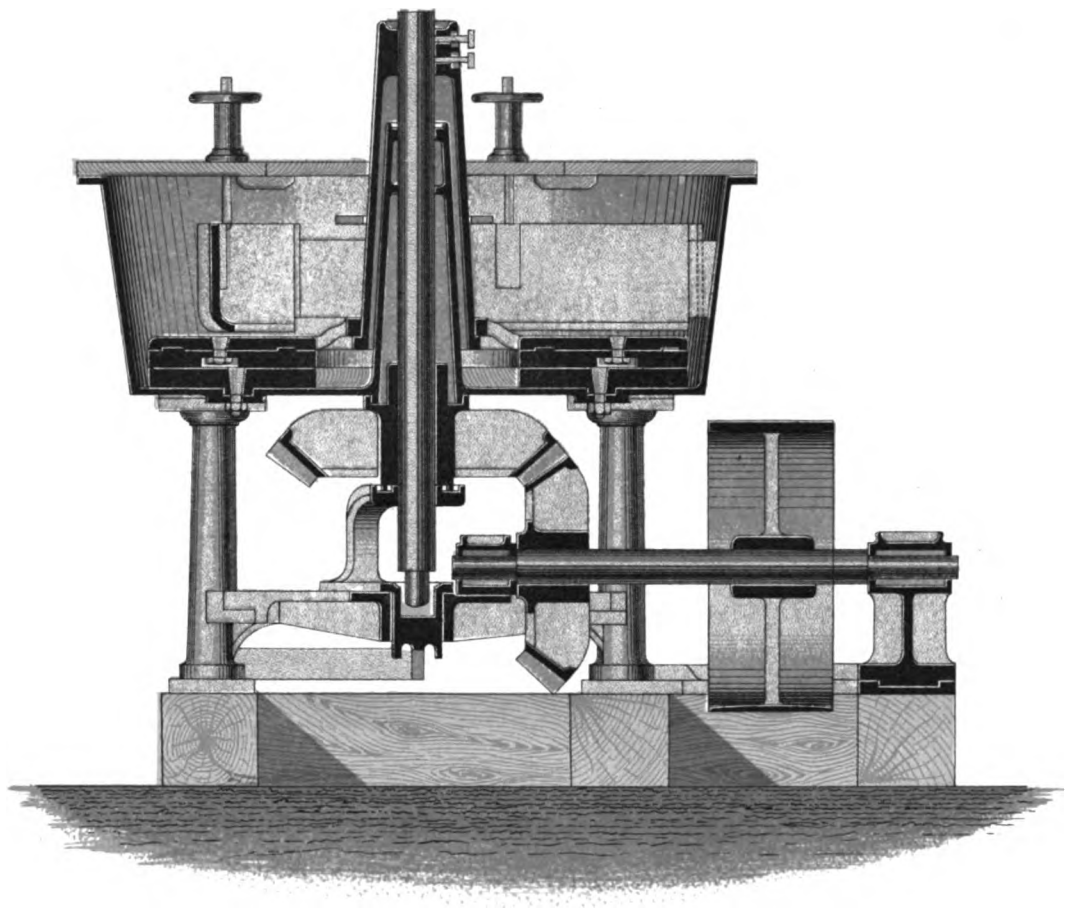


BY

DAGLISH & Co.

SECTION OF AMALGAMATOR
FOR
GOLD AND SILVER MINING.

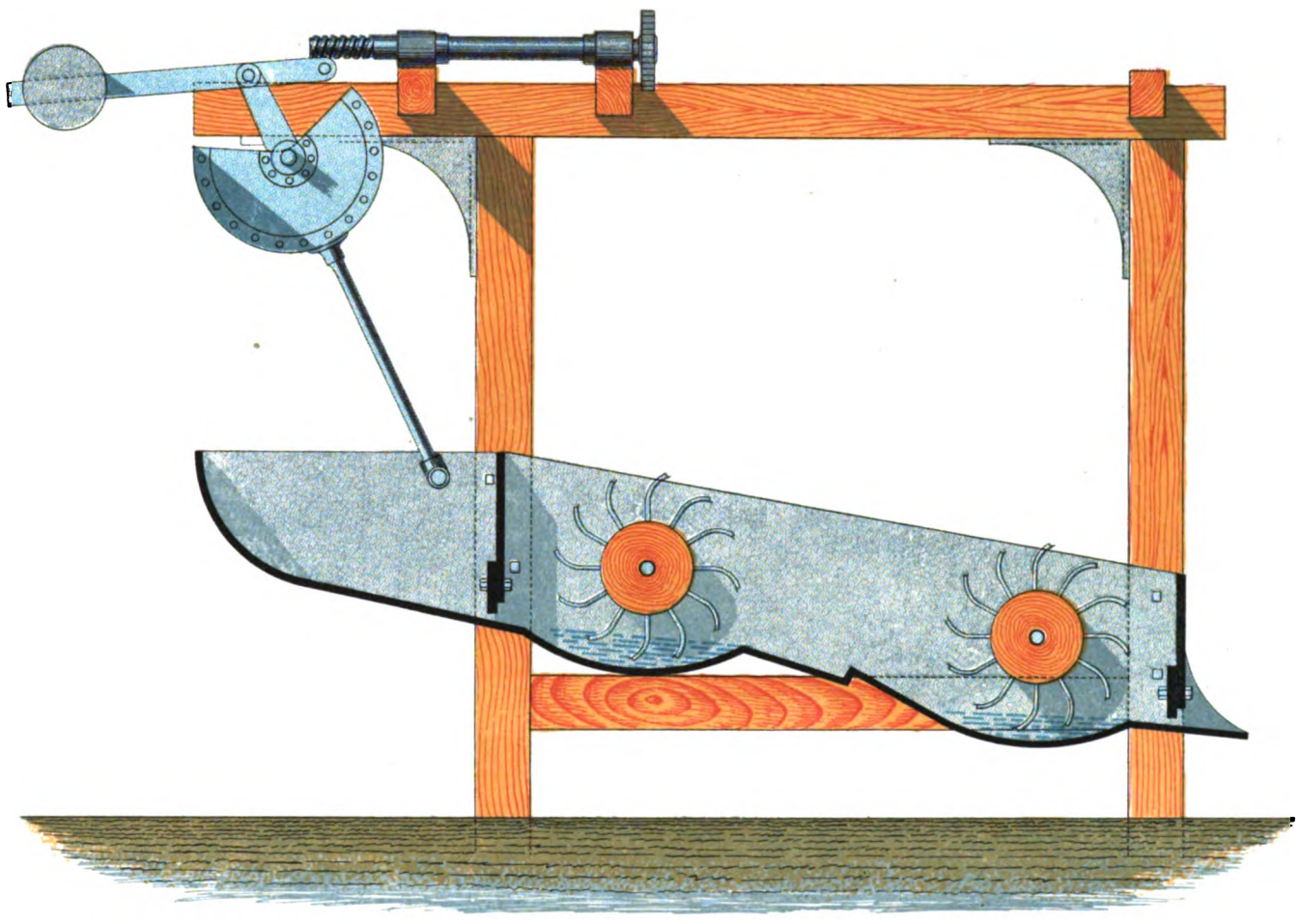
FIG 2



BY
DAGLISH & Co.

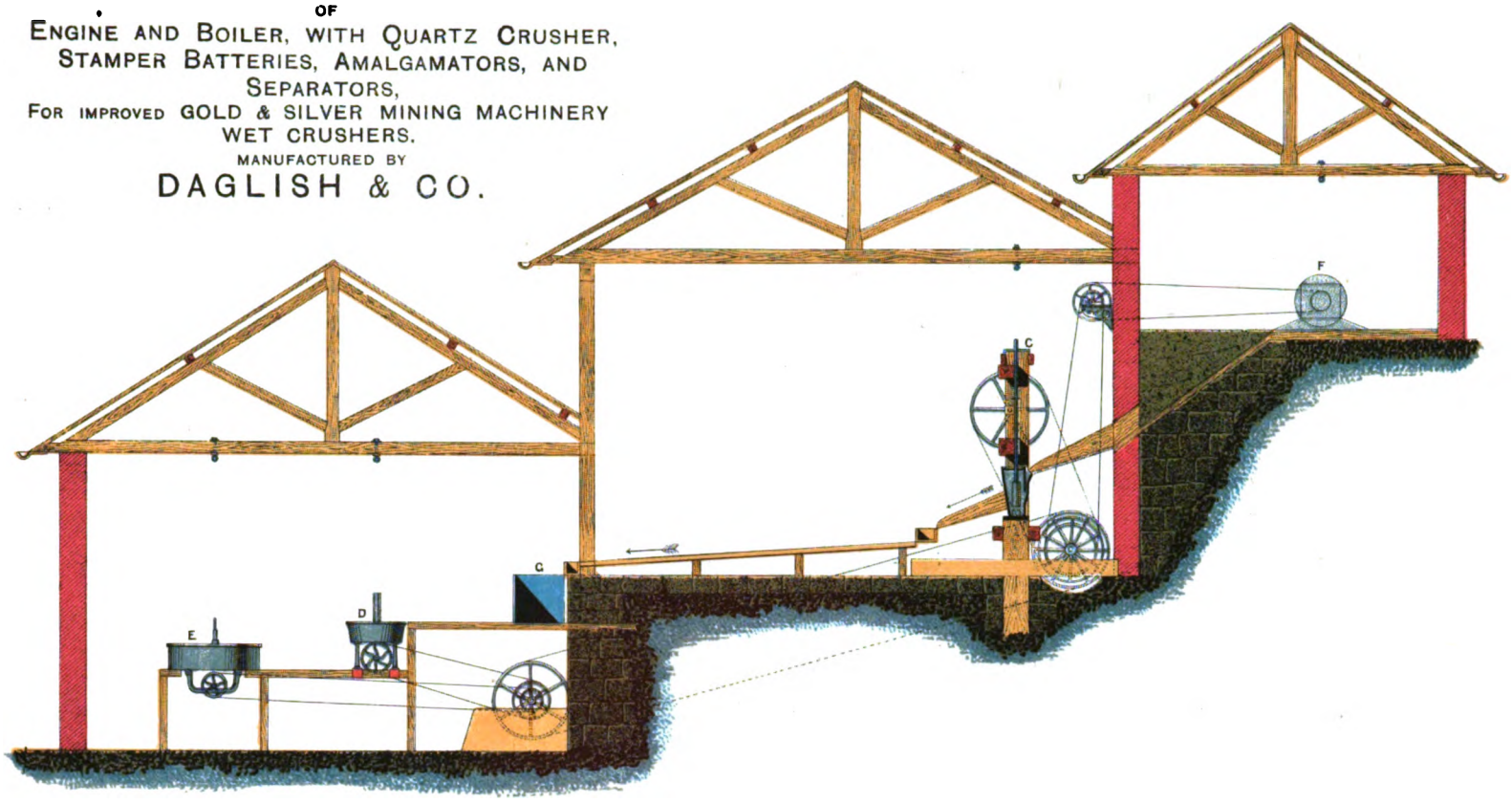
ELEVATION OF AMALGAMATOR
FOR
GOLD AND SILVER MINING.

FIG 3



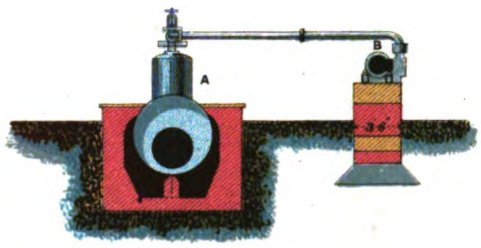
BY
DAGLISH & Co.

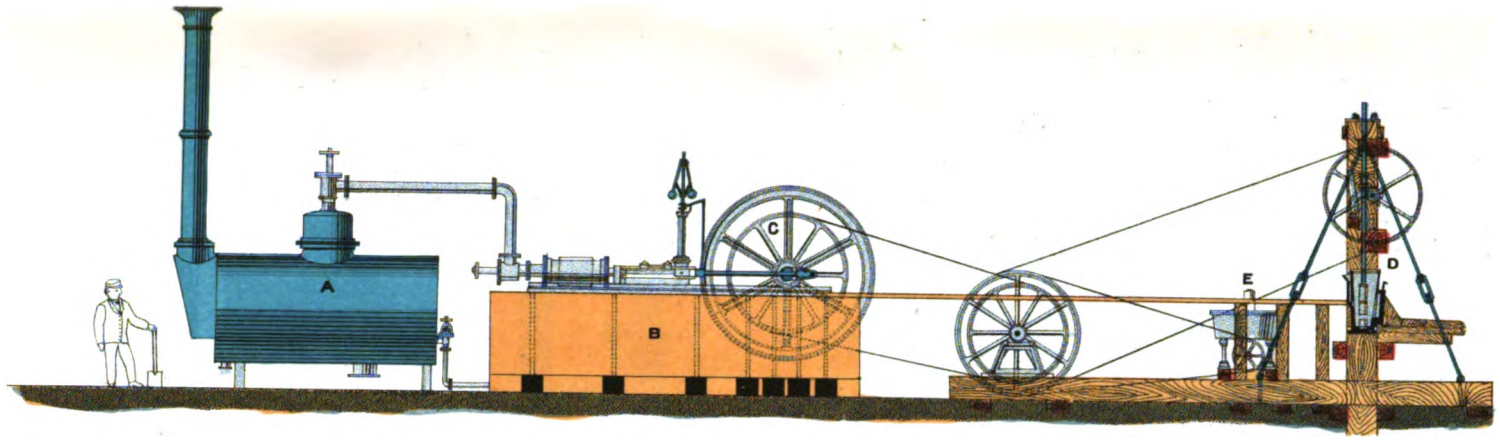
PLAN AND ELEVATIONS
OF
ENGINE AND BOILER, WITH QUARTZ CRUSHER, STAMPER BATTERIES, AMALGAMATORS, AND SEPARATORS,
FOR IMPROVED GOLD & SILVER MINING MACHINERY
WET CRUSHERS.
MANUFACTURED BY
DAGLISH & CO.

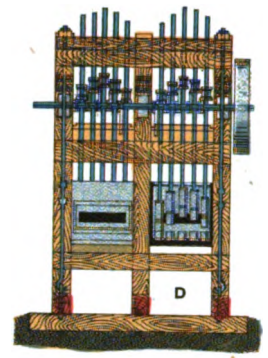


REFERENCE.

A.—BOILER.
B.—HORIZONTAL ENGINE.
C.C.—STAMPER BATTERIES (10 Heads each).
D.D.D.D.—AMALGAMATORS.
E.—SEPARATORS.
F.—QUARTZ BREAKER.
G.—TANKS.







REFERENCE.

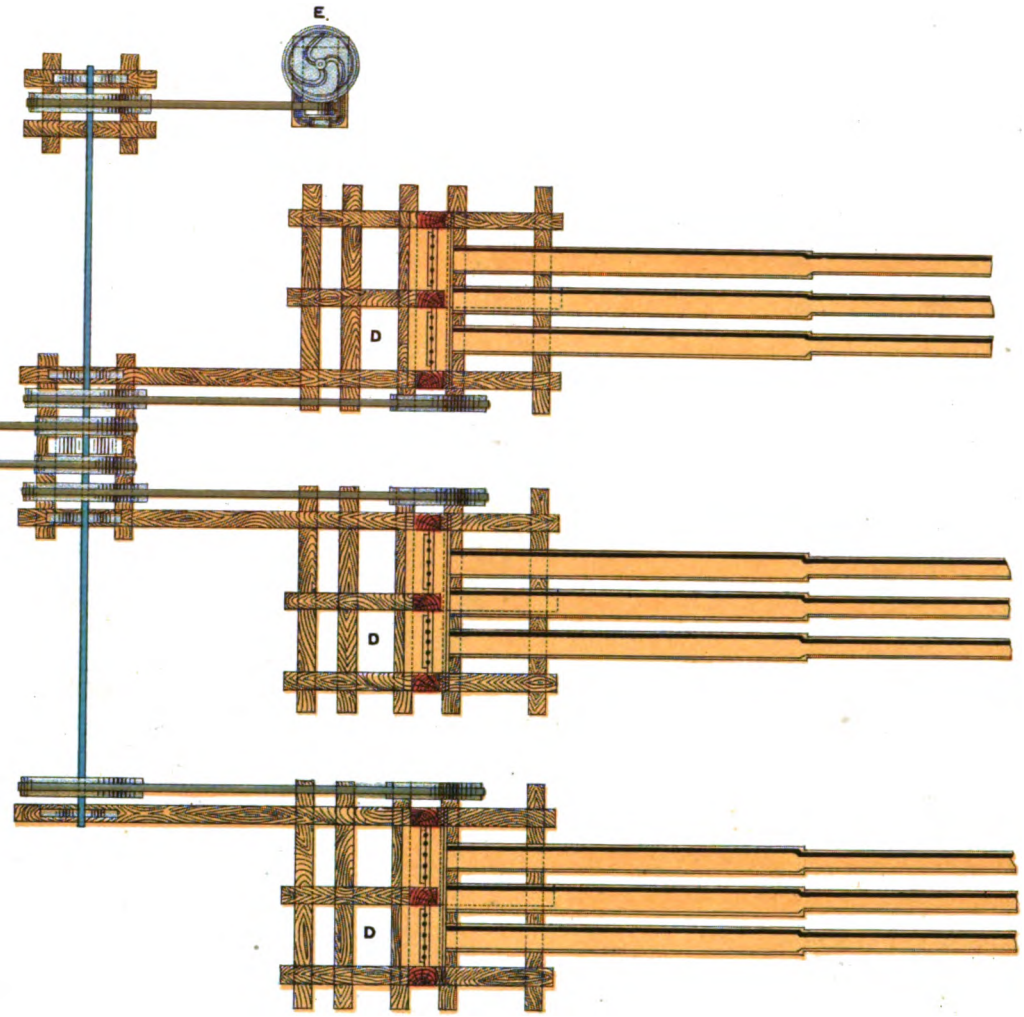
A.A.—PATENT SELF-CONTAINED MULTITUBULAR STEAM BOILER, WITH CHIMNEY SMOKE BOX, &c.

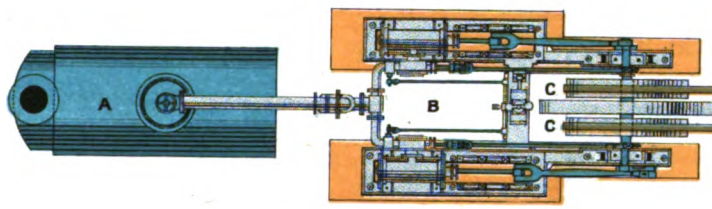
B.B.—HORIZONTAL COUPLED 30-HORSE POWER ENGINES AND FOUNDATIONS.

O.O.—DRIVING PULLEYS.

D.D.—STAMPER BATTERIES (each containing 10 Heads).

E.E.—AMALGAMATING MACHINE.





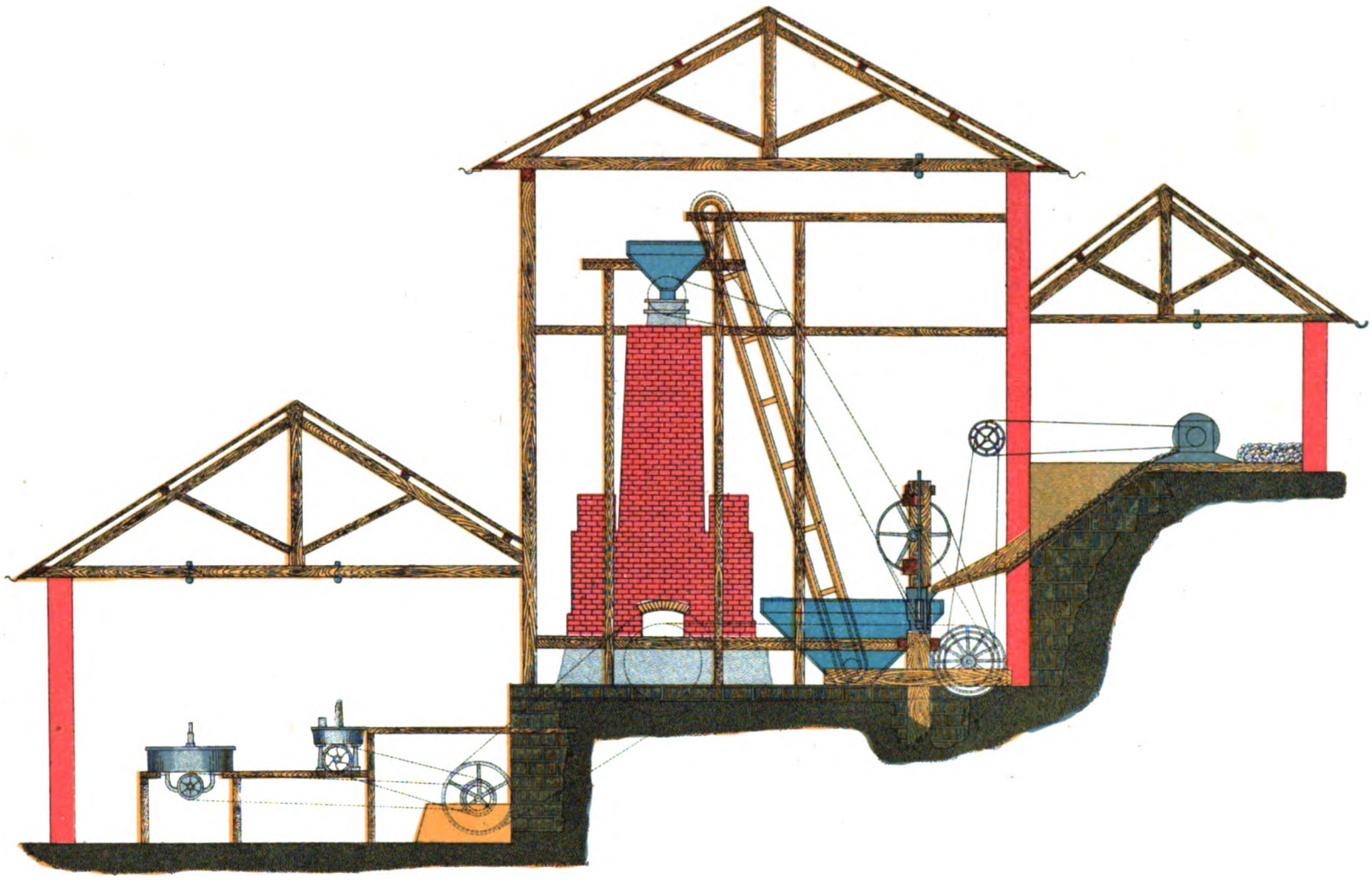
PLAN AND ELEVATIONS
OF
ENGINE, BOILER & STAMPING BATTERIES
FOR
GOLD MINING MACHINERY,
CONSISTING OF
SELF-CONTAINED MULTITUBULAR STEAM BOILER, COUPLED ENGINES, GEARING, &C.,
FOR DRIVING 3 STAMPER BATTERIES AND 1 AMALGAMATING MACHINE.
MANUFACTURED BY
DAGLISH & CO.

IMPROVED SILVER MILL,

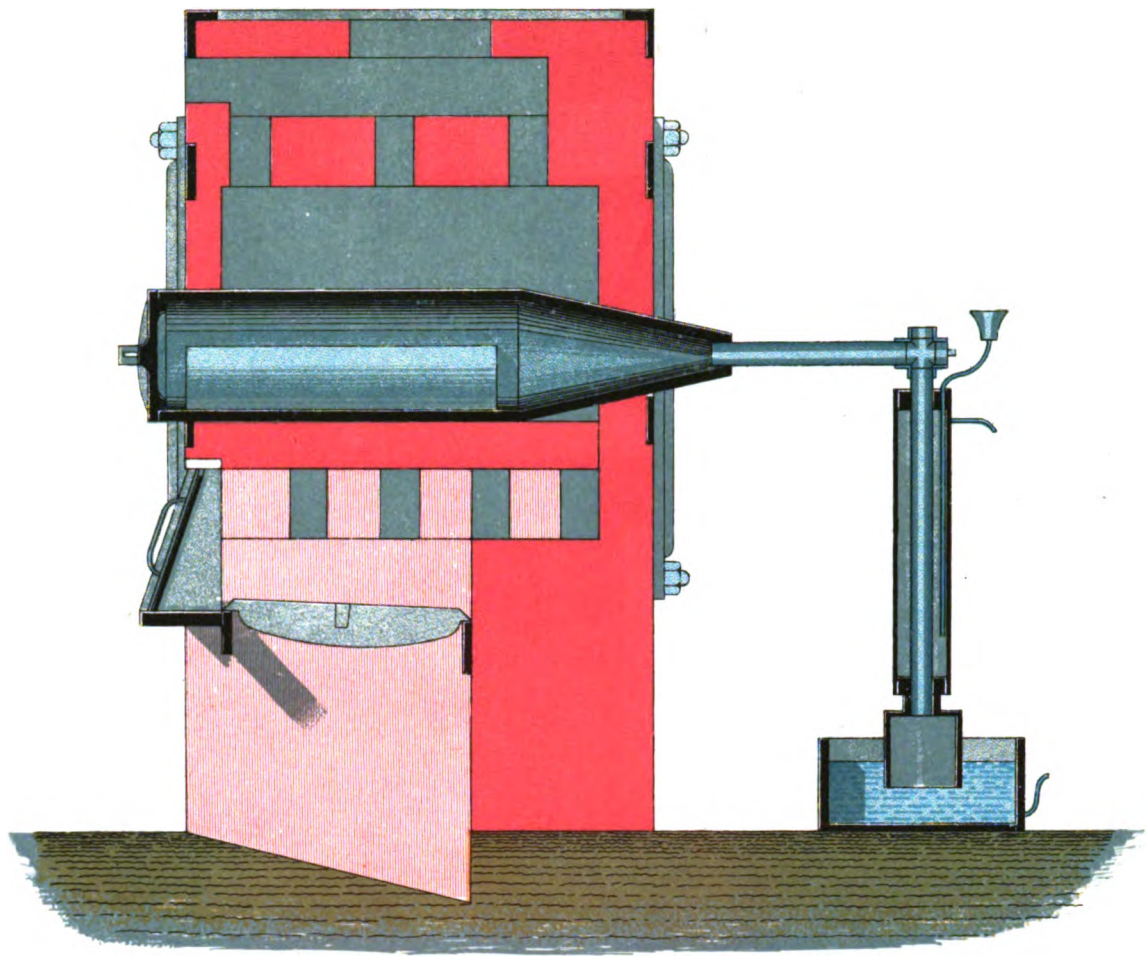
DRY CRUSHING WITH STETEFELDT FURNACE.

BY

DAGLISH & Co.



SECTION OF RETORT FURNACE FOR GOLD MINING.



The retort, as given above, can be used for retorting gold as well as silver whenever the quantity is large enough.

The condensed quick-silver filters through a bag fastened on the end of a pipe, and is received into a tray.

Two tiers of amalgam trays can be used in retort at the same time, one above the other.

INGOT MOULDS

Are of Cast Iron, with rounded corners and a slight taper, and are of different patterns. Copper is also used in the making of Moulds. Sizes vary

				Capacity in Ounces,	
From 1 in. by 5/8 in.	width and 1/2 in.	deep	... 2	Silver 4	Gold.
To 13 „ 6	„ 5	„	... 2000	„ 3675	„

EXAMPLES OF THE WORKING OF DIFFERENT QUARTZ MILLS IN AMERICA.

In practice it is found that heavy Stamps working at a higher speed with a short drop will do more work than lighter Stamps at a lower speed with a higher drop.

Wet or Dry Crushing	Dry.	Wet.	Dry.	Wet.	Wet.	Wet.	Wet.
Mill	Silver.	Silver.	Silver.	Silver.	Silver.	Gold.	Gold.
Number of Mortars	6	6	6	6	6	8	6
Discharge of Mortars	Double.	Double.	Double.	Double.	Double.	Single.	Single.
No. of Stamps to each Mortar	5	5	5	5	5	5	6
Total Number of Stamps	30	30	30	30	30	40	6
Weight of a Stamp in lbs.	750	750	750	750	750	750	650
Height of Drop in inches	8	9	8	7½	7½	8½	10
Number of Drops per minute	95	85	95	93	87	85	90
Screens made of Brass Wire	...	...	...	...	6*	...	...
Trade No. of Screens	50	6	50	50	6	5	5
Tons of Rock crushed in 24 hours	52	67	48	33	47	90	17
Tons crushed per Stamp in 24 hrs.	1·73	2.07	1·6	1·1	1·57	2·25	2·85
Quality of the Rock	Hard.	Soft.	Easy.	Soft.	Soft.	Medium.	Brittle.
Formation	Limestone.	Quartz.	Quartz.	Limestone.	Limestone.	Quartz.	Quartz.
Fineness of the Bullion	998	550	775	990	990	840	...

* Russian Iron, punched.

ROASTING FURNACES.

The roasting of Ores after pulverization has for its object the production of chemical changes of such a nature as that the combination of the precious metal with sulphur may be destroyed, and a new combination made with the Chlorine which leaves the metal in a condition most suitable for amalgamation.

For the reduction of Gold by Chlorination the Ore is not chloronized in the roasting.

Reverberatory Furnaces have been mostly used heretofore for roasting.

In them the Ore is spread on the hearth and kept constantly stirred, in order to present all the particles to the influence of the heated gases which pass over it.

For Chlorodizing, common salt is thrown into the Furnace, so as to spread evenly among the roasted Ore.

There are Roasting Furnaces of Stetefeldt and Aikens' pattern.

SMELTING FURNACES.

The Smelting Furnace most commonly used in the Pacific States consists of :—

Four cast iron columns, from 8 ft. to 11 ft. high, support a square cast iron plate having a circular hole about 4 ft. in diameter. In this plate is built the stack of the Furnace, with an opening through which the Furnace is charged. Under the plate, and inside the columns, is built the cylindrical shaft of the Furnace, filling the space from the foundation to the top plate. Three tuyeres, with water spaces, are placed at the proper height above the Bed of the Furnace, one at the back, and one at each side.

Smelting Furnace, with Deflects Flue, which is a modification of the ordinary or common Furnace.

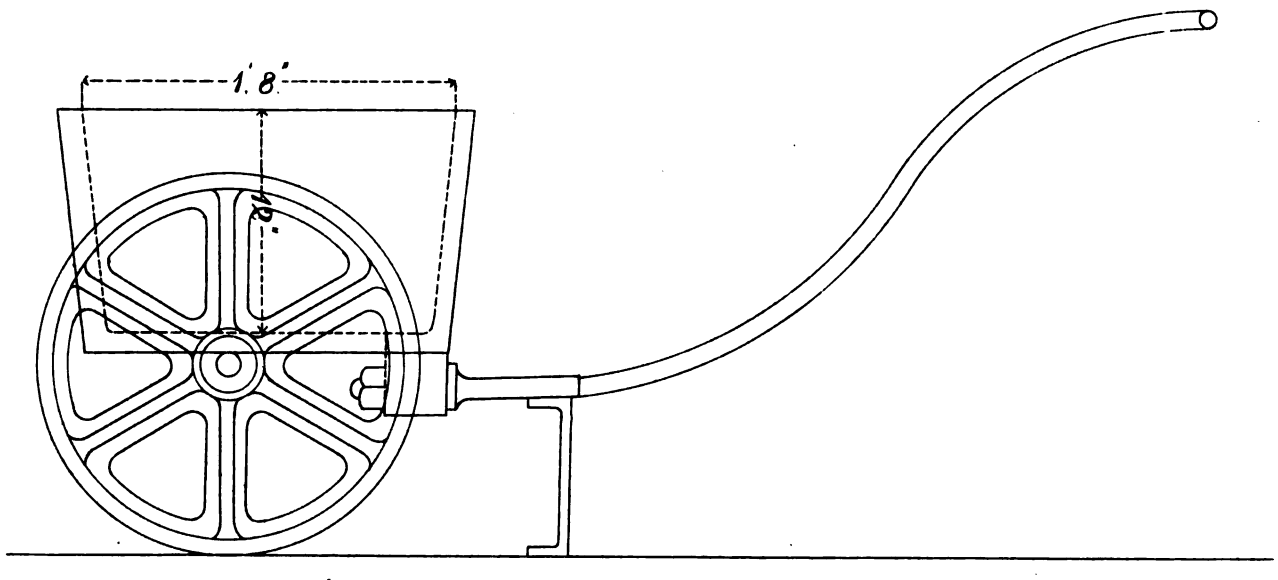
THE PILZ FURNACE.

It is built six-sided, about 10 ft. above the tuyeres, and 3 ft. 6 in. across. The front side is made somewhat wider than the others, and has an arch which is built up with a curtain thinner than the main wall. The curtain stops just below the level of the centre of the tuyeres, leaving an opening below for the slag to run freely into the gutter, and along to the slag pot. The base of the Furnace is bound with cast iron plates, and the Shaft with wrought iron straps.

Five tuyeres supply the blast, one in each side, except the front.

The charge passes through the hopper at the top, and a hood with a smoke pipe conducts away the fumes.

SLAG BARROW.



Is made of both cast and wrought iron.

LADLES

Are made of wrought iron, with socket riveted on the bowl, into which a gas pipe is screwed, and serves for a handle.

BULLION MOULDS

Are usually made of cast iron, and are of various sizes.

CHLORINATION OF GOLD ORES.

This process was first introduced by Plattner, of Frieberg, and is based upon the solubility of gold in Chlorine Gas. The resulting compound is easily soluble in warm water, and from this solution the gold is precipitated as a metallic powder by green vitriol, oxalic acid, &c., &c.

This is the whole theory.

In treating ores by this process, however, a great many difficulties present themselves, which, being entirely of a chemical nature, can be overcome only by a thorough chemist.

The presence of sulphur, arsenic, or antimony makes the process impossible. Ores containing over ten per cent. of their value in silver cannot be treated profitably. Any metal present in the ores in a state of oxidation lower than an oxide has the same effect. All ores containing sulphurets must therefore be roasted.

For roasting on a small scale the Bruckner Cylinder Furnace is the best, while the Stetefeldt Furnace is to be preferred for extensive works.

In the construction of modern Chlorination Works several important improvements have been introduced, we believe, by Messrs. Riotte and Luchardt, of San Francisco.

The plant used in such a works consists of Bruckner Furnace, Leach's Vats, Gas Generator, Precipitating Tubs, and Gas Wash Bowl.

NOTES AND TABLES ON GOLD MINING.

WATER REQUIRED IN WORKING QUARTZ.

Each stamp uses 10 lbs. per minute.
Each pan uses 16 lbs. per minute.
Each settler uses 9 lbs. per minute.

If the water is run from the mill into settling tanks it can be saved with a loss of 20%. This will make the actual supply of water required in lbs. per minute to be as follows :—

For :	One stamp	2 lbs.	per min.
	One pan	3·2	,, ,,
	One settler	1·8	,, ,,

POWER REQUIRED FOR A 60 STAMP MILL.

							Water required in lbs.
60 stampers	at	1⅛ H.P.	each	...	67·5 H.P.	... ...	600
22 pans	,,	4 H.P.	,,	...	88·0 H.P.	... ...	352
11 settlers	,,	3 H.P.	,,	...	33·0 H.P.	... ...	99
3 concentrators	,,	2 H.P.	,,	...	6·0 H.P.	... ...	
1 rock breaker			...	...	5·5 H.P.	.. ...	
Friction			...	...	25·0 H.P.	... ...	
						... ...	169
Total power required			...	...	225· H.P.	... ...	
						Total water required	1,220 lbs.

Of which 1,051 lbs. used for—

Stamps, pans, and settlers, can be re-pumped to the tank at a loss of 20%, and the 169 lbs. for the engine can be condensed at a loss of 50%. This will leave the actual amount to be supplied as follows :—

20% of 1,051 lbs.	... ...	210·2 lbs.
58% of 169 lbs.	... ...	84·5 lbs.
	Total water per minute	294·7 lbs.

ESTABLISHED 1798.

DAGLISH & Co.

Engineers, Boiler & Bridge Makers, Millwrights,

BRASS AND IRONFOUNDERS,

Manufacturers of every description of

CONDENSING OR HIGH PRESSURE, BLOWING, PUMPING, ROLLING AND WINDING ENGINES,

Of any required power for Irrigating, Draining, Mining, Rolling Mills or Water Works Purposes.

SPECIALITIES MANUFACTURED AS UNDER:

Alizarine Plant.
Acid Pumps of Lead for Sulphurous Acid.
Air Engines and Pumps for Acid Forcing.
Agitators for Chemical Manufactories.
Animal Charcoal Plant complete.
Bending Machines, Patent and Power.
Black Ash Revolving Furnace on the most approved construction.
Boat Pans of Wrought or Cast Iron.
Blowing Engines as supplied Weldon's Patent Process.
Caustic, Chlorate, Decomposing, Nitre, Nitro-Glycerine, Iodine, Potash, Sulphur, Acid and Oxalic Pans.
Castings in Dry, Green-sand, and Loam, of any weight.
Crushing Machinery for Rock Salt, Copper Ore and Pyrites.
Creosoting Machinery.
Copper Extracting Plant complete.
Chemical Manufacturers' Plant of every description.
Contractors' Plant.
Copper Ore Mining Machinery.
,, Washing Machines.
,, Crushing Mills.
Coal Tips and Hoists.
Patent Conical Winding Drums up to 36 feet Diameter.
Cranes, steam overhead travelling, up to 30 tons.
,, ,, ,, up to 16 ,,
,, Steam Wharf, up to 60 tons.
Cylinders of Cast Iron up to 30 tons.
Dredging Machinery.
Forge and Rolling Mills.
Gold Mining Machinery.
Glass Machinery for Crown and German Sheet.
Glass Machinery for Plate complete.
Grinding Machines for Glass.
Hoisting Machinery for Coals, Mills, &c.
Hydraulic and Steam Hoists.
Incline Plane Pulleys.
Iodine Plant from Sea Weed.
Head Gear Framing for Collieries, of wrought iron.
Jaw of Hard Metal for Stone Crushers.
Loam Mills with hard Metal Rollers and Bottom Plates.
Manure Phosphate Plant.
Mill Gearing of every description.
Mining Machinery for Coal, Copper, Gold &c.
Nitre Pots.
Nitrate of Soda Plant.
Oxydising Steam Towers for Caustic.
Pyrites Burners and Mills for Irish, Norwegian, and Spanish Ores.
Punts for Sugar Canes.
Pipes of any size and weight.
Pots for Pearl Ash, Sulphate of Ammonia, and Soda Crystals.
Pumps and their Fittings.
Plate Glass Machinery.
Polishing Benches for Crown and Plate Glass.
Phosphate Manure Plant.
Pit-Head Pulleys to 20 feet diameter.
Retorts—Acid, Gas, Iodine, Nitro, Nitro-Glycerine, and Vitriol Refining.
Riddle Revolving, for Coal, Copper, and Salt.
Roofs of Wrought Iron.
Saltcake Pans.
Screw Propellers in Brass and Iron.
Sulphur Pots, Flour and Roll, and Steam Sulphur Melters.
Sawing Machinery, for Greenheart and other Timber.
Steam Super heaters improved for Oil, Tar, and Resin Refining.
Steam Sulphur Melter and Sulphur Pans.
Stills for Oil, Resin and Tar.
Tar Dye Plant complete.
Turntables.

Wheels—Bevel, Mitre, and Spur, Moulded on the shortest notice by Patent Machinery.

OVER 2000 PATTERNS. LISTS SENT ON APPLICATION.

BY ROYAL LETTERS PATENT.

MANUFACTURERS OF EVERY DESCRIPTION OF

CHEMICAL MANUFACTURERS' PLANT

On the most approved Plans, and as supplied to the largest Alkali Makers in England, Ireland, Scotland, Wales and Continent. Photographs and Plans supplied on receipt of orders.

GEO. H. DAGLISH'S PATENT CONICAL WINDING DRUMS.

GEO. H. DAGLISH'S PATENT WINDING ENGINES.

MACTEAR'S ✣ PATENT ✣ CARBONATING ✣ FURNACE.

Jones and Walsh's Patent Sulphate of Soda Furnace, Parnell and Simpson's Patent Causticizer, and

KYNASTON'S PATENT ALUM PLANT.

Provand's Patent Apparatus for obtaining Fresh Water from Sea Water by Condensation.

Improved Revolving Furnace for Calcining Copper Ore.

ST. HELEN'S ENGINE, FOUNDRY, BRIDGE & BOILER WORKS,

LANCASHIRE.

Entered at Stationers' Hall.] PARTICULARS AND PRICES GIVEN ON APPLICATION. [*All Rights Reserved.*

1886.

BEMROSE AND SONS, PRINTERS, DERBY; AND 23, OLD BAILEY, LONDON.